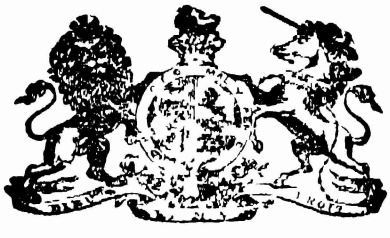
REPORT

ON THE

CAWNPORE EXPERIMENTAL FARM;

FOR THE KHARIF SEASON, 1882.



ALLAHABAD:

NORTH-WESTERN PROVINCES AND OUDH GOVERNMENT PRESS.

1883.

No. 397A. of 1883.

From

The DIRECTOR, DEPT. OF AGRI. and COMMERCE,
North-Western Provinces and Oudh,

To

The SECRETARY to GOVERNMENT,
North-Western Provinces and Oudh.

Dated Cawnpore, the 17th March, 1883.

Sir,

I have the honor to submit Major Pitcher's report on the Cawnpore Farm for the late kharíf harvest. Its submission is unavoidably delayed until the results of the cotton crops have been ascertained.

2. Last year's experiments were spoilt by excessive floods, which obliterated the differences between the various experimental plots, and, in the case of the most important of the new products, by an unavoidable want of experience. No such drawbacks have to be reported this year.

3. Some progress has been made towards eliminating disturbing causes in the plots set apart for the comparison of the effects of various kinds of manure. The original standard plots, having been left entirely unmanured for four harvests in succession, have now been treated with exactly the same manures for five further consecutive harvests. The duplicate plots have nearly attained the same degree of experimental accuracy. But there are so many disturbing causes independent of the mere treatment of the soil, and over which the farmer has little or no control, that experiments of this kind, however carefully conducted, must be extended over a long series of years before their results can venture to claim any conclusive scientific authority.

4. As far as they go, the trials of various kinds of manure confirm the main results of previous years and point to nitrogen as the element in which the soil of the farm is deficient. On four standard plots the average produce given by nitrogenous manures was 2,138lb. per acre, while that given by phosphates and manures not rich in nitrogen only averaged 1,337lb. On the duplicate plots the averages were 1,695lb. and 1,014lb. respectively. The increase in outturn was 60 per cent. in the first case and nearly 70 per cent. in the second.

5. The experiments with deep and shallow ploughing for cotton show a decided advantage on the side of moderately deep ploughing even in a year when a copious supply of rain diminished the necessity for it. The continued use of the inverting plough on the Farm lends no countenance to the fear, which is not unfrequently expressed, that it may eventually lead to the deterioration of the productive powers of the soil.

6. The advantages of early ploughing are so very generally understood that I agree with Major Pitcher in thinking that this series of experiments may be discontinued.

7. The sowing of cotton in drills was tried for the first time on the farm this year. The result showed an increase of 39 per cent. in cotton and 30 per cent. in seed over a crop raised on the plan which is generally used in these provinces. The experiments will be repeated next year.

8. Another system, which, as far as I know, is never practised by the native agriculturist, yielded most satisfactory results. New Orleans and Upland Georgian cottons rattooned, and in the second year of their growth gave double and half as much again as the produce of plants sown this year. The American cottons maintained their very high price in the Cawnpore market at a time when native cottons were suffering a most serious decline, and realized Rs. 23-12-0 per maund, while good Bengal only commanded Rs. 13-12-0.

9. The result of sowings in different qualities of soil showed, as they did last year, that while the native Kulpahar pays best on a light loam, it is far distanced by American cotton where the soil is heavier.

10. The ravages of a little-known species of caterpillar, which attacked only the American cottons on the neighbouring estate of Rawatpur, and was not found on the Farm at all, were the cause of some anxiety, and the reappearance of the insect will be looked for next year. At first it was feared that the crop might have been almost entirely destroyed; but when I last saw the Manager, he informed me that, though the leaves had been eaten, a very large proportion of the cotton had escaped.

11. The trial of Nankin cotton will be repeated next year. A fibre with a good natural colour, which does not fade, would be of considerable commercial value.

12. Perhaps the most important of the experiments with products were those with different kinds of sorgo. Even in America the exact value of this plant as a sugar-producer has not been finally determined, but its great agricultural importance is widely recognized. It has three great advantages over the cane—in yielding a grain fit for human consumption; excellent fodder for cattle; and in taking up the land for four months only instead of a whole year. In addition to this, it requires hardly any manure and no irrigation. Of three varieties tried, the amber and the red, while they yielded a rather less proportion of juice and gur to the whole plant than sugarcane, were not inferior to it in the proportion to the cleaned canes. The gur, though not yielding so large a proportion of crystal as ordinary sugar and possessing a peculiar acidity, was well-flavored and commanded a higher price in the market. For eating and various manufacturing purposes it appears to have a good future.

13. The great difficulty is in its manufacture, and this is where failure was encountered last year. This year Major Pitcher gave every stage of the process his personal attention; and I was much impressed when I was staying at the Farm by the incessant care he devoted to it, and the scrupulous cleanness of the gur turned out. It is possible that his practical knowledge of chemistry may suggest before next harvest some method for reducing the objectionable quantity of glucose; but the present product has a market value which would make the cultivation of the plant very remunerative. Before, however, it can be hoped to spread, it will be necessary to instruct the natives who are to grow it in the proper method of preparing the gur, and this is a subject which will receive attention next year.

14. The experiments in *Ensilage* proved, at any rate, that fodder can be kept in good condition for a long time, and probably from one rainy season to another. In these provinces this is a question the importance of which cannot be over-estimated, and experiments will be continued with the view of ascertaining the cheapest way in which effective silo pits can be made. They may become of the very greatest value in connexion with the scheme of fodder reserves which is under the consideration of Government.

15. The Kaisar plough has gained prizes at a number of agricultural shows, and its merits are beginning to be more generally appreciated than hitherto. More than double the number were sold during this half-year than in the corresponding period last year. Where the soil is heavy and better bullocks and a larger price can be afforded, there can be little doubt of the superiority of the Watts' plough to all Indian adaptations from European or American models; and a considerable number have been ordered in the hope that they may suit the requirements of the Upper Doab.

16. Considerable improvements have been made in the Farm water-lift, and it is possible that a still better Form of plug may be discovered. As it stands, it is a very useful and effective implement; but the new form of exercise it imposes on the native who uses it seems to be an obstacle to its general introduction. It is possible that this may disappear as its advantages are better understood. In the meantime the demand remains about what it was.

17. Major Pitcher has been in charge since the transfer of Mr. Fuller to the Central Provinces in July, and the post of Overseer has been held by Lachman Prashad Barma.

I have the honor to be,

SIR,

Your most obedient servant,

W. C. BENETT,

Director.

REPORT

ON THE

CAWNPORE EXPERIMENTAL FARM

For the Kharif Season of 1882.

1.—FIELD EXPERIMENTS.

As compared with the seasons experienced at the Farm for several years past, the kharif season of 1882 may be taken to have been fairly good. The rains commenced early, and with the exception of a continuous fall in July and long break in August the showers were fairly distributed. The total rainfall closely approximated the normal rainfall as shown below :—

Month.	Rainfall in inches.	Number of days in which rain fell.
June	11·2	9
July	6·8	15
August	6 9	11
September	1 5	4
October	·5	1
November	·0	0
Total	26 9	40
Normal rainfall during the period	26·5	...

In July, weeding was somewhat interfered with by the continuous rain. In August, maize suffered during the long break from 6th to 21st August, and the village crops around the Farm gave a very poor outturn. The variety grown at the Farm and known as Jaunpur maize flowers later than the ordinary country variety ; it had suffered therefore less by the time that the canal (which happened during the break to be closed for repairs) was again thrown open.

2. The operations of the season comprised experiments on—

(1) Manures.
(2) Deep and shallow ploughing.
(3) Early and late ploughing.
(4) Drill and broadcast sowing.
(5) Cotton.
(6) Sorghum sugar.
(7) Ensilage.

3. (i) **Manures.**—The plots on which manures are tested are now arranged in duplicate. Each plot measures one-twelfth of an acre, and the duplicate series provides some check on the results of the standard series.

For the past four years the treatment of both standard and duplicate series has been as under:—

Year.	Season.	*Standard plots.*		*Duplicate plots.*	
		Manure.	Crop.	Manure.	Crop.
1878 to 1879	Kharif ...	*Nil* ...	*Nil* ...	No record ...	No record.
	Rabi ...	*Nil* ...	Barley ...	Ditto ...	Ditto.
1879 to 1880	Kharif ...	*Nil* ...	Cotton ...	*Nil* ...	*Nil*
	Rabi ...	*Nil* ...	Fallow ...	Bone superphosphate ...	Wheat.
1880 to 1881	Kharif ...	*Same as now applied	Maize ...	*Nil* ...	Fallow.
	Rabi ...	Ditto ...	Wheat ...	*Nil* ...	Ditto.
1881 to 1882	Kharif ...	Ditto ...	Maize ...	Same as now applied ...	Maize.
	Rabi ...	*Nil* ...	*Nil* ...	*Nil* ...	*Nil*
1882	Kharif ...	See return ...	Maize ...	See return ...	Maize.

* An exception is the plot which was this year treated with saltpetre ; in 1880-81 it was treated with poudrette.

For the season under report each plot was treated as under—

Ploughed	...	...	...	... Three times with Watts' plough.
Weeded	...	...	...	... Twice.
Irrigated	...	...	...	... Once.
Seed sown	...	...	...	... Maize at 6 seers per acre.

The following table shows the manures experimented with and the results :—

Manure and rate per acre.	Outturn per acre.			
	Grain.		*Stalk and leaf.*	
	Standard.	Duplicate.	Standard.	Duplicate.
Manures yielding nitrogen.	lb.	lb.	Maunds.	Maunds.
Cattle-dung, 180 maunds	2,169·0	2,020·5	95·4	89·7
Cattle-dung, 180 maunds, and bone-dust, 360 lb. ...	2,434·5	1,845·0	102·9	87·6
Cattle-dung, 180 maunds, and gypsum, 240 lb. ...	1,758·0	1,704·0	87·6	82·5
Saltpetre, 240 lb.	2,190·0	1,278·0	111·9	93·3
Ditto and bone dust, 360 lb.	...	1,626·0	...	87·6
Manures yielding little or no nitrogen.				
Bone superphosphate, 240 lb.	1,422·0	1,378·5	84·3	81·0
Bone-dust, 360 lb.	1,417·5	844·5	79·8	56·7
Gypsum, 240 lb.	1,056·0	912·0	58·5	75·0
Ashes of 180 maunds cattle-dung...	1,452·0	922·5	87·3	71·4
No manure	1,002·0	924·0	74·7	69·0

4. Nitrogenous manures, as may be seen, maintain a very marked superiority in yield as against manures yielding little nitrogen ; and the duplicate plots corroborated fairly the results of the standard plots save in the case of the saltpetre standard plot, which shows a variation due probably to unexhausted poudrette (*vide* note to table of previous treatment).

There is little to be learnt, however, from experiments which have as yet so little continuity; and patience must be exercised until a sufficient number of annual experiments have been carried out to enable us to assert positively that by a certain expenditure on any particular manure corresponding increase in produce can be obtained, returning a fair profit on such expenditure.

5. (ii) **Deep and shallow ploughing.**—A new field was selected for these trials to which for several years past no manure had been applied, and which had hitherto been cultivated with the native plough alone. It had further been reduced in fertility by crops of maize and wheat in succession. The field was divided into four plots, each measuring exactly one-sixteenth of an acre and separated from its neighbour by a pathway four feet wide. The plots were thus treated—

I. and IV.—Ploughed twice at sowing time with a native plough.

II.—Ploughed once at sowing time with a Kaisar plough to a depth of 5 inches.

III.—Ploughed once to 9 inches at sowing time with a Collins' plough.

Cotton was sown broadcast, harrowed in and a *patela* run over the fields.

The crops were weeded twice and were not irrigated.

The yield was as under.

Number of plot.	Detail of ploughing.	*Actual outturn.*				*Outturn per acre.*	
		Cotton.		Seed.		Cotton.	Seed.
		lb.	oz.	lb.	oz.	lb.	lb.
I.	Native plough	5	15	12	10	95	202
II.	Kaisar ,, ...	7	0	14	5	112	229
III.	Collins' ,, ...	6	9	13	6	105	214
IV.	Native ,, ...	6	4	13	0	100	208

It is to be regretted that space was not available for larger plots, and an endeavour will be made next year to secure more ground. The present figures are evidence in favour of moderately deep ploughing rather than ploughing to great depth. Here, however, again we must wait for continuous series of trials before drawing conclusions that can be generally accepted.

6. (iii) **Early and late ploughing.**—Two series of plots were prepared for experiments with maize and cotton respectively. The plots intended for maize came to an untimely end through the bursting of a rájbáha in May, which levelled all distinctions.

The cotton plots were four in number. Two fields were selected at some distance from each other and were each divided into two plots.

In each field one plot was ploughed in May and again at sowing time, while the other plots were only ploughed at sowing time. A crop of wheat had been taken off each field in the previous season ; no manure was applied nor were the crops irrigated, but each plot was weeded twice.

The following table gives results :—

Number of plots.	Area in square yards.	*Actual outturn.*		*Outturn per acre.*	
		Cotton.	Seed.	Cotton.	Seed.
		lb.	lb.	lb.	lb.
I.—Early ploughed	2,472	83	193·75	162 5	379 3
II.—Late ploughed	2,217	65·5	156·0	142·9	340 5
III.—Early ploughed	1,691	58·5	117 3	167 4	356·7
IV.—Late ploughed	2,122	66·75	130·5	152·7	297 6

7. The advantage of early ploughing is demonstrated from the above, as has been done in previous experiments, but I am not aware that its advantages were ever contested. In Oudh every native is aware of the advantage derivable from the ploughing of unoccupied fields after every good fall of rain between November and the monsoon, and considers each of such ploughings as equivalent in benefit to manuring the land. Even standing green arhur is ploughed between the rows. It seem to be purely a question on the part of the cultivator of leisure, or of bullock power, being available, and I would propose to discontinue this series.

8. (iv)—**Drill and broadcast sowing.**—In these provinces it is usual to sow cotton broadcast, but in the Central Provinces cotton is sown in drills. The merits of the two systems were put to test side by side in a field divided into two plots, the treatment of which in previous years had been as under :—

Year.	Manure.	Crop.
1879-80	*Nil.*	Mandua.
1880-81	*Nil.*	*Nil.*
1881-82	*Nil.*	Wheat.

The drills were two feet apart, and the seed was sown at intervals of two feet: The two plots were sown with Kulpahar seed and treated as under :—

Manure	Ploughed.	Weedings.	Irrigation
Nil	Once in May and again at time of sowing.	Two	*Nil.*

The area and outturn of each plot were as follows :—

Mode of sowing.	Area in square yards.	*Actual outturn.*		*Outturn per acre.*		*Increase per acre.*	
		Cotton.	Seed.	Cotton.	Seed.	Cotton.	Seed.
		lb.	lb.	lb.	lb.	lb.	lb.
Drill	3,320	130·12	311·5	189 7	454·1	51·8	106·4
Broadcast ...	3,654	104·12	262·5	137·9	347·7	...	...

As the price realised for the Kulpahar cotton grown by the Farm was Rs. 15-8-0 per bazar maund, and the price of the cotton seed is about Re. 1 per maund, the above experiment shows a profit of about Rs. 9-4-0 per acre in sowing in drills over sowing broadcast.

The experiments will be repeated in future years.

9. **(v) Exotic cottons.**—The following kinds were experimented with :—

1.—New Orleans.
2.—Upland Georgian.
3.—Nankin cotton.

Two plots sown in July, 1881, were ratooned for a second crop, and six plots where sown this year.

The treatment of these in past years and the present is shown in the following table, togegether with the results :—

Number of field.	Area in square yards.	Nature of soil.	*Previous treatment.*			*Treatment during present year.*					Outturn of cleaned cotton per acre in lb.
			Year.	Manure.	Crop.	Manure.	Ploughing.	Watering.	Weeding.	Seed sown.	
I.	3,541	Light loam	1879-80	Guano ...	Wheat ...	Dung, 100 maunds to the acre.	2	*Nil.*	2	New Orleans,	95
			1880-81	*Nil.*	Sorgho.						
			1881-82	*Nil.*	Wheat.						
II.	4,227	Do.	1879-80	*Nil.*	Wheat ...	*Nil.*	Do.	Do.	Do.	Do.	90
			1880-81	Dung,	*Nil.*						
			1881-82	*Nil.*	Wheat.						
III.	336	Heavy loam.	1879-80	Poudrette,	Maize ...	*Nil.*	*Nil.*	Do.	I o	New Orleans ratooned.	190·7
			1880-81	*Nil.*	*Nil.*						
			1881-82	*Nil.*	Cotton.						
IV.	5,622	Light loam,	1879-80	*Nil.*	*Nil.*	*Nil.*	2	Do.	Do.	Upland Georgian.	110·4
			1880-81	*Nil.*	*Nil.*						
			1881-82	*Nil.*	Wheat.						
V.	5,201	Do.	Sam	e as of No.	IV. ...	*Nil.*	Do.	Do.	Do.	Do.	72·7
VI.	1,155	Heavy loam.	1879-80	Poudrette,	Maize ...	*Nil.*	*Nil.*	Do.	Do.	Upland Georgian ratooned.	144·5
			1880-81	*Nil.*	*Nil.*						
			1881-82	*Nil.*	Cotton.						
VII.	1,037	Do.	1879-80	*Nil.*	*Nil.*	*Nil.*	2	Do.	Do.	Nankin.	91·8
			1880-81	Guano,	Sugarcane						
			1881-82	Bone superphosphate.	Wheat.						
VIII.	1,625	Do.	Sa	me as No.	VII. ...	*Nil.*	*Nil.*	Do.	Do.	Do.	113·9

10. Continuous showers in July interferred with the weeding of the crops raised from seed, and the plants were checked somewhat in growth. The ratooned crops, besides being on rich soil, were from their more vigorous growth less affected by the vicissitudes of season. The produce of the New Orleans and Upland Georgian was valued by the Elgin Mills at Rs. 22-8-0 per maund of 82 lb. equivalent to Rs. 27-7-0 per bazar maund, while last year the valuation was Rs. 25 ; and as the bazar prices of country cotton are lower this year than last, it seems clear that the acclimatised seed has not degenerated.

11. Samples of American and of country cotton cleaned with the Emery saw gin and with the ordinary country charkha were submitted to the Manager, Elgin Mills, for opinion, from whom the following report was received :—

'With reference to your letter, dated 11th instant, forwarding samples of cotton, I have the honor to report as follows :—

2. The samples received were—

1. Upland Georgian—saw ginned.
   Ditto— charkha ditto.
2. New Orleans— ditto ditto.
   Ditto— saw ditto.
3. Kulpahar— charkha ginned.
   Ditto— saw ditto.
4. Country cotton—ditto ditto.
   Ditto— charkha ditto.

3. After carefully examining the above samples and comparing the cotton ginned with the native charkha in the ordinary manner with that ginned with the Burgess (Emery) saw gin I have arrived at the conclusion that the staple has not been injuriously affected by the latter process, *i. e.*, cut, broken, or otherwise appreciably damaged, while the superiority of the saw gin over the old primitive method is very marked, so far as opening out and cleaning the cotton is concerned; as applying to the first two varieties, *viz.*, Upland Georgian and New Orleans.

The effect of the saw gin on the short-stapled country cotton, however, is that the seed is partially broken in the process, and small particles adhering to the fibre are passed through the machine, which materially reduces its value for spinning purposes.

I am of opinion, therefore, that the Burgess saw gin, while doing its work admirably on the long-stapled varieties, is not so well suited for cotton grown in the North-Western Provinces usually known as Bengals.

4. The following are, approximately, valuations of the samples according to the ruling prices of the day:—

Georgian and New Orleans	...	... Rs. 22-8-0	per maund of 82 lb.
Kulpahar and country cotton	...	... „ 16-0-0 and 16-4-0	ditto.

Following the above opinion, the whole of the American cotton was saw ginned, while the country cotton was cleaned by charkha; and the prices eventually realised were Rs. 23-12-0 for American, Rs. 15-8-0 for Kulpahar, and Rs. 15-4-0 for country cotton per bazar maund respectively.

I may note that a sample of the country cotton cleaned by the saw gin and sent to the Cawnpore market was rejected by the dealers not on account of any supposed injury to the staple, but on account of its clean appearance, the dealers suspecting that it was old cotton cleaned with a Behna's bow.

12. Comparing the value of the exotic cottons with the produce of country cotton grown at the Farm, we find as follows:—

Kind of cotton.	Class of land.	Produce per acre of cleaned cotton.	Value per acre of cleaned cotton.
		lb.	Rs. a.
Country cotton	Light loam ...	178·6	35 2
Exotic New Orleans and Upland Georgian ...	Ditto ...	92·0	25 4
Ditto ditto ditto ...	Heavy loam ...	167·6	45 15

showing, as was done last year, that in heavy loam the exotic cotton is a more paying crop than country cotton, even though the latter were to yield up to 200 lb. per acre; while in light loam it is country cotton which is most profitable.

The cotton hand-books of Bombay, Madras, and Bengal, together with that for all India, compiled by Dr. Royle, have left little to discover in the way of experiments with exotic cottons, so far as the English home market is concerned; and it was established clearly that India could never hope to compete successfully at Manchester with America in American cottons: but since then times have changed, and the question now is whether the exotic cotton cannot be grown for local mills with success and with great profit to the ryot and to the spinning companies.

The Farm experience is so far favourable to an affirmative. At the Rawatpur estate, which is but a short distance from the Farm, the success of American cotton has been very marked: the cultivators are, I understand, beginning to appreciate the high price obtainable, and the cultivation is likely to extend.

13. Last year and again this year the American cotton plants at Rawatpur were stripped of their leaves by swarms of caterpillars, which left the adjoining fields of country cotton absolutely untouched, nor did they visit the fields on the Experimental Farm.

It seemed at first as if the crops would be damaged, but I understand the yield has been fairly good.

As the caterpillar was a stranger to the cultivators of the district, I kept some of the chrysalises until a moth emerged and then tried to get the latter identified. The Agri-Horticultural Society of Bengal returned a caterpillar first sent without being able to recognize it, their only authority having left for England. Then the moth travelled to the Panjáb and to Simla, and at last found a resting place at Poona, where it was kindly identified by Lieutenant-Colonel Swinhoe, Assistant Commissary-General, Bombay Army, who writes us as follows to confirm a first opinion:—

Dated 21st February.—"I have to-day received from Mr. Arthur Butler, of the British Museum, the specific name of the little moth you sent me: it is *Glyphodes Multilinealis of Guenèe.* Mr. Butler says it is common and it appears widely distributed.

"The cotton you sent me with your letter, 18th December last, I put carefully though a process of drying and heating, and have succeeded in hatching out three moths, all of one species, and each of them came out of the heart of a separate injured cotton pod; and I can't help thinking that this is the real insect that has been damaging the cotton. I took it myself out of a cotton-field near Karachi four years ago, and sent specimens of it to the British Museum. It was pronounced to be a new species of the tribe *Tortrices,* family *Nycteolidæ,* and was named by Mr. Butler *Erias tristrigosa.*

I don't mean to say that *Glyphodes Multilinealis* has not been injuring your cotton. Probably both insects have been at your cotton, one in its leaves and the other in the pod."

It may be interesting to others who may come across rare specimens to know that Lieutenant-Colonel Swinhoe has a collection of over eleven hundred species of moths.

14. *Nankin cotton.*—Of this variety it is necessary, in view of the interest lately taken in it, to make a separate note.

To all appearance, in the field before the bolls burst, the plant is the same as that of New Orleans or Upland Georgian, and quite different therefore in growth and leaf to country cotton. It was grown at the Farm some few years ago, but discontinued owing to the unfavourable reports on its staple received from Calcutta. This year some seed was received from the Saháranpur Botanical Gardens and from the Rawatpur estates, where it had been grown, as well as on other estates in the Cawnpore district, for several years past. On the plant the cotton is of a dirty fawn colour mixed with white; bolls of fawn-coloured lint and of pure white lint being sometimes found on the same plant. After ginning, spinning, and weaving the result is a dark khaki-coloured cloth of uniform tint, admirably adapted for army clothing. The colour can, apparently, be bleached, judging from a coat shown to me at the Elgin Mills, but does not appear to fade with ordinary washing and wear. The Mills object to its staple as being difficult to work with machinery, and the English operatives at the Elgin Mills say that on account of this difficulty it is known to the trade in England as "rotten cotton;" a difficulty, however, which does not seem to be recognised by native weavers.

This cotton is cultivated in Central India and woven into cloth for the regiments of Central India Horse. Lieutenant-Colonel Martin, C.B., in reply to inquiries, has kindly sent two samples of cloth of first and second quality. The Officer Commanding the 23rd Pioneers has sent samples of cloth and cotton from crops raised near Mian Mir by Subadar-Major Natha Singh, A.D.C.; and from the Government of Madras have been received specimens of the cotton, and of cloth manufactured from it at the Coimbatore jail. From the Cotton Hand-book of Madras it appears that samples of Nankin cotton took prizes at the Madras Exhibition in 1859. The Secretary to the Muir Mills, Cawnpore, writes:—

"This Company has grown for some years crops of this cotton and have manufactured drill from the same. I enclose a pattern of the drill for your examination. We have endeavoured to introduce the cotton among the cultivators, but have not succeeded to any extent. We purchase any quantities of the cotton we may have offered to us, but at present very small quantities have been secured, and we are therefore unable to manufacture cloth for sale of the pattern sent you."

All the samples of Nankin cotton received appear to be of fairly uniform colour save that from the Muir Mills, which is brighter and lighter than the rest, though but a slight shade different to the first quality of cloth used by the Central India Horse.

In the report of the Mission to Yarkand, page 479, reference is made to a reddish-coloured cotton sold in the Yarkand bazar and known as *kárá kiwáz,* which maintains the colour after washing. Lieutenant-Colonel Gordon, C.B., to whom I sent specimens of the Farm-grown cotton, speaking from recollection, seems to think Nankin identical with *kárá kiwáz,* and has kindly promised to try to procure seed from Yarkand.

To sum up: Nankin cotton has long passed the experimental stage. It has been grown successfully, has been woven successfully, and is approved of by those who have had good opportunities of observing it in use; but of value there are not at present sufficient data, as, owing to absence of demand, the market rate has been purely nominal.

The figures for the small quantity grown on the Farm, as shown in the table in para. 9, give an average of 102·8 lb. of clean cotton per acre on good soil, a poorer yield certainly than that of country cotton or New Orleans ; but the crop will probably give another picking in April, and may, on the whole year's outturn, compare more favourably.

15. *Sorghum sugar.*—The attempts of last year to manufacture sugar from sorghum were renewed this year and with better success. Two fields were sown.

(1) was divided into three sections, which were respectively planted with Minnesota early amber, acclimatised red sorghum, and acclimatised black sorghum. The field was manured with farmyard manure at 100 maunds to the acre.

(2) An unmanured plot in which sorghum was planted for cattle-food.

Contrary to expectation, the unmanured plot gave a better crop than the manured plot. This may have arisen from the fact that No. (1) lies lower than No. (2), and was waterlogged for some time in July. In America the general opinion is in favour of a sandy upland soil well drained, but not freshly manured. A professional sugar-boiler (kindly procured for the Farm by Messrs. Thomson and Mylne) could make nothing out of the juice at first, and pronounced it impracticable. One of the Farm apprentices, accustomed to sugar-boiling, then tried his hand on it, and by the use of lime succeeded at last in making gur of fairly good quality from the early amber and the red varieties, but for a long time failed with the black variety: eventually succeeding with that also by adding a very small quantity of carbonate of soda, as well as lime, to the boiling juice.

16. Samples were sent to Carew and Co., Limited, to Messrs. Thomson and Mylne, and to the Agri-Horticultural Society, Bengal. A sample was also submitted through a native gentleman to a committee of sugar-brokers in Lucknow, the manner and place of its production being carefully concealed. The following opinions were received :—

MESSRS. CAREW AND CO.

" I have now the pleasure to send analysis of your sample of sorghum and to remark—

" 1st.—It is very acid. Having no experience of sorghum juice, I do not know how far this is due to delay or accident in manufacture.

" 2nd.—The amount of glucose is large and is probably due to the acid, which has the effect of converting crystallizable sugar into glucose, if present in a heated solution.

" 3rd.—Each part of glucose present is held in refining to convert another part of crystallizable sugar, and this with the allowance for ash reduces the available sugar from your sample to 24 per cent.

" As a rule we would decline sugar with so small a result.

" My valuation is of course for refining purposes.

" It is pronounced here less sweet to the taste than cane gur ; but it seems to me that, in small quantities, reaching the market early, it should bring top prices, *viz.*, Rs. 3-8 to Rs. 4 per maund.

Sugar analysis.

Sample received—November, 13th.
Marked Amber Sorgho Gur, 2oz.
Description,—Gur.
Colour, &c.—light yellow—*Very acid.*

Composition.

Cane sugar	61·00
Glucose	23·85
Ash	3·15
Insl. matter—sandibre	0·23
Colouring matter extractive	3·78
Water	7·99
Total	100·00

Available sugar 24·5%."

MESSRS. THOMSON AND MYLNE.

" The sample of gur you sent us is of the kind made for eating, and is not used for making sugar ; the present highest rates for eatable gur and gur for making sugar are 13½ and 15 seers per rupee respectively, and the value put upon your sample is 12½ to 12¾ seers per rupee."

Lucknow and Cawnpore native brokers valued it at 9 to 10 seers per rupee, expressly placing a higher value on it than on what fresh sugarcane gur would fetch a month later, on account of its early appearance in the market, and as a fact sugarcane gur is now selling in Cawnpore (in March) at 14 seers per rupee.

The Agri-Horticultural Society wrote as follows :—

"The samples above referred to are worthy of consideration, both being products of some value, if properly and carefully prepared.

"The plant is well known—sorgho or sorghum, the seed of which yields a hard food-grain, capable of being ground into good white flour. It is also used for cattle-feeding purposes, the green fodder of the plant being highly nutritious and sweet.

"The sample of gur said to have been prepared from the expressed juice of this plant is very soft, pasty, sticky and devoid of all granulation.

"In its present hard, dry condition it would be saleable in the bazar at about Rs. 2-8 or Rs. 3 a bazar maund; but if subjected to a damp atmosphere, or kept during the rainy season, it would quite change its character and become dissolved in the form of molasses, in which state it would be suitable for distilling into spirit only, and worth about Re. 1 to Rs. 1-8-0 a bazar maund.

"I am however of opinion that with care and cleanliness in boiling the expressed juice, and better manipulation generally, this plant is capable of yielding a good marketable gur; that further efforts should be made to improve upon the sample now under consideration, and in doing so that details should be given of the cost of producing it and that a large sample be furnished."

It will be observed that the Society's differs considerably from the professional opinions on this product and from the verdict of the market.

To revert to the professional opinions. Another given later on by Messrs. James Saunders and Co., of Melbourne, of samples from the Farm forwarded to them by the Government of India, runs thus :—

"Memorandum by Messr. James Saunders and Co., of Melbourne, on Sorghum sugars :—

"*Sample* :—Three samples have been received as follows ;—Red sorgho, black sorgho, amber sorgho, and are herewith returned.

"*Mode of valuation.*—These were shown to a sugar-broker of 10 years' London experience, and his separate opinion quite agrees with the writer's.

"*London value.*—The amber quality has been taken as a test, and the broker gives it a value of £15-10-0 in London.

"*Net price to cultivator.*—Allowing £1-10-0 a ton for freight, bagging, shipping, and commissions, which would fully cover all in case of large shipments direct from port to London, a net balance of £14 per ton remains. From this, London brokerage, 1½ per cent., and carriage to port of shipment have to be taken; the latter omitted, the available money for distribution would be say £ 13-15-0 (about Rs. 6 a maund).

"*Uses.*—These depend on—

(*a*) quantity of saccharine per cent.

(*b*) quantity of crystallising matter per cent.

As it now stands it is most likely to be of use to brewers, as the demand by refiners for low class "Mauritius" and even down to Madras 'jaggeries' compels them to often use crystals.

"*Use in Australia.*—The above remarks apply with even greater force, crystals of low count being almost invariably used. There would therefore be strong hope of better price in Victoria, which is the chief brewing centre; but this would be counterbalanced in part (at least for a time) by higher freight, which with charges would by sail be 55s. to 60s.

"*Proposed trial.*—Regular supply should it be desired to try it in Victoria; one quality should be selected, say 'amber;' all available information condensed and forwarded with (say) a ton to our firm, on which a report on the market value and experimental use can be made; but it should be borne in mind that, for trading purposes, it is useless to go to trouble and expense, unless a regular and constant supply can be kept up."

17. These points are so far plain that at the present stage of these experiments, the gur produced is better adapted for eating purposes in India and for export for brewing purposes than for refineries. The best samples have a strong taste of honey, and coming early into the market, it should have a ready sale. As a fact, I may note that a native gentleman of Cawnpore, with whose name and appearance I am quite unacquainted, bought at the Farm as much as the Superintendent would sell him at four annas a seer, and soon after returned to ask for more at the same price. The high price was put on simply because we did not then wish to sell, and at the same time did not wish to disoblige anxious enquirers.

18. The acidity of sorghum juice is far greater than that of cane and constitutes a difficulty. In using lime-water as a preliminary test, as recommended by Dr. Shier, I found the proportion of lime requisite to produce complete neutrality to be about 2oz. to 100 gallons of juice, where Farm sugarcane required about 1½oz.; but in the actual boilings the tempering must be done very carefully, so as to avoid alkalinity, which blackens the juice; and we deemed it advisable to err for this season, considering the small quantity of juice available, on the side of acidity. Next season I propose to try lime sucrate as being more manageable and of more constant quality than rough milk of lime. This is recommended in "Sugar Growing and Refining," a book full of the latest information on the subject, which was received by the Farm rather late for this year's operations.

The greatest care was taken to avoid fermentation. The canes were stripped on the fields before being cut and were pressed as quickly as possible after cutting. An attempt to save labour by pressing the canes with the leaves on (as sometimes practised in America) proved a great failure. The vessels for holding and boiling the juice were carefully cleansed and fumigated daily with sulphur, and the juice filtered, before boiling, through fine flannel. All the operations of pressing and boiling were conducted as with sugarcane. A Bihia mill was used for pressing, a few drops of castor-oil to aid clarification, and lime was used for tempering, as already stated.

19. It remains to note the yield, which is shown in the following table. The cane was throughout much the same in quality, but day's workings were varied by experiments, of which it is sufficient if what succeeded fairly is noted :—

Variety.	Percentage of clean canes per maund of plants.	*Percentage of juice.*		*Percentage of gur to weight of*		
		Plant.	Cleaned canes.	Plant.	Cleaned canes.	Juice.
Amber	43·45	21·45	49·36	3·61	8·32	16·86
Red	44·20	23·14	52·35	4·04	9·14	17·46
Black	40·22	21 64	53·81	3·05	7·58	14·09
Sugarcane, variety chin	58·38	27·78	47·52	4 76	8 16	17·18

The average produce per acre of the three varieties was as follows:—

	Maunds.
Weight of plant	125·00
Ditto cleaned canes	53·27
Ditto gur	4·44
Ditto grain	3·00

Value of produce per acre—

	Rs.	a.	p.
Gur at Rs. 4 per maund	17	12	0
Grain at Re. 0-12-0 maund	2	4	0
Tops and leaves for fodder at 10 maunds per rupee	9	8	0
Vinegar	1	0	0
	30	8	0

Cost of production per acre—

Manure, 100 mds.	3	0	0
Ploughing twice	1	8	0
Clod-crushing	0	4	0
Sowing	0	12	0
Seed	0	4	0
Weeding	2	0	0
Cutting	2	8	0
Rent for kharif	4	0	0
Sugar-boiling at Re. 1-12-0 per maund of gur	7	14	0
Total ...	22	2	0

It may be repeated that the crops were exceedingly poor.

No one would claim from the above that any great success had been achieved; but criticism may be deprecated, either for or against, for several seasons to come. A congress of sorghum-

growers and sugar-manufacturers was held in America only so late as January, 1880, at which statements were made showing considerable diversity of treatment of the plant, where all were anxious to promote its cultivation.

Meantime, if in the place of mere criticism others would take up the subject and make known any advance effected, sorghum may yet find a good place amongst Indian crops.

20. Its advantages are that it can apparently be grown as an ordinary kharif crop on poor land year after year without irrigation, and does not require the great labour, expense, and capital requisite for sugarcane. It only occupies the ground four months, and can be grown in places where sugarcane cannot be grown at all. If too poor a crop for sugar, it is still a most nutritious fodder for cattle, the seed being also good food. If fine enough for sugar, it keeps the mills going for a month earlier. Cattle eat the *megass* greedily, while they will not eat that of sugarcane. The leaves and tops also go to the cattle. From fermented juice alcohol can be distilled, and from the skimmings of the boiling-pan vinegar can be manufactured. Sorghum may therefore be said to have potentialities.

21. **(vi) Ensilage.**—Some experiments were made in ensilage about two years ago, when the conclusion was arrived at that the system would never succeed in India, the fodder in the silo on the latter being opened having been found in a high state of putrefaction. It did not however appear from the record that the fodder had in these experiments been packed so as to exclude the air, and in view of the increasing attention which the subject is receiving in Europe and America it seemed advisable to try again.

To avoid all possible elements of failure, one silo was simply a large tin-case let into the ground in which 8½ maunds of fresh-cut green juar stalks were packed ; the juar was cut small with a chaff-cutter and packed by layers, each layer being well trodden down, covered with tarred paper and three inches of earth above to keep out the air. It was left for 48 hours, after which the covering was removed, the fodder retrodden to assist consolidation, and a fresh quantity put in.

Some salt being sprinkled on each layer, a final covering of six inches of earth was given. In this miniature silo there would be no question of failure to carry out instructions.

A larger silo was a disused masonry reservoir, into which 51½ maunds of green juar were packed in as above described.

The silos were packed between 3rd and 25th September, 1882.

It must be borne in mind that the object sought was, not to show how a silo could be most economically constructed, but to establish whether green fodder could be stored at all.

The intention was to keep the silos closed until the hot weather, and tarpaulin was placed in readiness in case of rain ; but in my absence occurred the heavy rainfalls of January 23rd and 26th, and rain was allowed to soak right through the covering of earth and some six inches of the top layer of fodder.

On the 28th January I had both silos opened. Where rain had penetrated the fodder was rotten and mouldy and white-ants were busy. Below however the fodder was perfectly good, looking green and succulent and with a sweetish vinous odour. The Farm cattle not only eat it greedily, but when placed before them in a basket alongside a basket of ordinary cut chari showed a distinct preference for the silo fodder. Five seers at morning and five seers at evening were given to each of several lean kine until the silo was exhausted. A question was whether cattle could be fed on the fodder entirely with safety. For this an undesirable animal was selected which never kept condition : no one would take him at a gift, and two attempts to lose him across the Ganges had proved ineffectual, a day or two always finding him back, grazing on experimental crops. Silo fodder alone was given to him, as much as he chose to eat. Next morning he was reported as looking " rather sulky," but nothing worse came of it, and he continued to eat as much as he could get while the silo lasted.

In the case of the large silo the damaged layer was removed and a fresh covering of dry earth laid on. It will be opened in April. Every week in England sees more information added

to the ensilage question, and by next season the knowledge now possessed of the subject will be far more complete. Originally it was insisted that the fodder must be free from rain or dew, and cut small, which latter operation constitutes a great expense. Now it is said that wet fodder uncut may be harvested this way. The covering with an air-tight material of each layer is dispensed with by some save in the case of the last layer. For consolidation planks are used, kept down by heavy weights, such as boxes filled with puddled clay. There are roadless tracts of country in these provinces, where more juar stalk is grown than the cattle can consume or the people dispose of, though the cattle are generally numerous in such parts. Long before the end of the cold weather the chopped karbi has to be soaked in water to be at all eatable, and by the end of Phagun it is past chopping for. In such situations a cheap mode of preserving fodder green till April, May, and June might be a boon. In other places when all surplus fodder can be sold it is a question whether a cultivator might not employ his money better in maintaining for hot weather fodder a field of mangold-wurzel, lucerne, or Guinea-grass.

It may be noted that the large silo was first tried with ordinary *dhub* grass, butthe first layer in three days resembled in appearance a mass of farmyard manure, and grass was not persevered with.

B.—AGRICULTURAL IMPLEMENTS AND MACHINERY.

22. The following ploughs were received for trial during the season under report :—

A native plough from the Panjab.

Two ploughs made at the Saidapet Farm.

Three Swedish ploughs also from Saidapet.

Two English ploughs from Messrs. Ransomes and Jeffries.

Two ploughs from Colonel Woodcock, District Superintendent of Police, Sultanpur.

Of the two English ploughs, one catalogued as marked P.L.K. is a very small one, giving a depth of furrow of 3 inches only ; the other marked W.K.S. is an exact copy of the now discarded form of Kaiser, which was sent to England two years ago. It carries with it such faults as the original Kaiser possessed.

The Swedish ploughs are quite unsuitable for cattle of these provinces, being very heavy, both in weight and draught : their price is also excessive, being Rs. 18 per plough, exclusive of freight from Madras ; while the Watts' American plough can, under recent arrangements with the manufacturers, be delivered at Cawnpore at Rs. 10, and possibly for less. The ploughs made at the Saidapet Farm are equally in weight and draught unsuitable for these provinces.

Of the ploughs received from Sultanpur, the main difference between them and the Kaiser is in the substitution of nuts and bolts for rivets and of a wooden for an iron standard, which necessitates reduction of the breadth of the beam at a point where strength is required, and in the breast being more curved, resulting in a cleaner furrow, but at the expense of greater draught.

The Panjab plough is similar to that in use in the Muzaffarnagar district, with a moveable breast. It is heavier than either the Watts or Kaiser, and does not invert the soil.

23. Besides frequent trials at the Farm, all the above ploughs, with the exception of the Panjab plough, were sent for exhibition to Saháranpur, Bijnor, Khairabad, and Bulandshahr. In each case either the Watts' or the Kaiser caught the judge's approval. Sales have somewhat increased this season, as shown in the following statement :—

Name of plough.	Sold.		Given for trial.	
	1881.	1882.	1881.	1882.
Kaiser	205	430	11	24
Watts' beam	...	13	...	5
B. F. O. beam	...	23	...	5
Total ...	205	466	11	34

One gentleman, an indigo-planter of Tirhoot, purchased 105 Kaisers. I sent him a Watts' for trial and opinion and received the following reply :—

"I can't say that I approve of it half as much as the Kaiser for indigo land preparations. For not only is the price double and the draught much heavier on the bullocks, but it is much too heavy for the ploughman to carry about from place to place, to and from his work, which is most essential for us. I have used some of the Kaiser ploughs now for about two years, and they are as good as new, except the continual wearing out of the shares, which is of course to be expected."

The Collector of Hydrabad, Sinde, in writing for a fresh supply lately of six Watts' ploughs, reported that the plough "has been pronounced by Mr. W. Strachan, Superintendent of the Model Farm, Hydrabad, to be a complete success. The stilt handle is, however, fully six inches too short for the average Sindhi, who to use it has to walk with his body bent, which soon tires him. The iron fittings also are of inferior quality."

In the garden of a native gentleman, Munshi Shiu Pershád, at Bareli, may be seen an example of sugarcane grown under cultivation with the native plough and with Kaiser plough respectively growing side by side, and the difference in favour of the Kaiser is, I have been told by the late Collector, very marked.

I have seen a like difference also this year in contiguous fields of barley grown in the Rae Bareli district. The true place for the soil-inverting ploughs is in the early preparation of the soil, particularly in indigo and sugarcane lands. The finishing ploughings and the sowings are best done with the native plough. Its introduction should be confined in the first instance to sugarcane, cotton, and indigo growers. Success with these crops will lead to its extension to other and less valuable crops. Unfortunately much of the so-called absence of enterprise in the people arises from a suspicion that increased production means to the landlord increased assessment and to the cultivator increased rent.

24. **Waterlifts.**—Some modifications have been introduced. The stand has been strengthened, the diameter of the wheel increased, and for wooden plugs, grooved iron plugs with a leather fitting to the groove and projecting from its edge, so as to fill the tube of the lift, have been substituted,

The result is increased efficiency; but this efficiency, easy to maintain and to demonstrate at the Farm, is not so easily maintained elsewhere, unless those who indent for lifts take care to renew the leathers when worn, and can appreciate the fact that the lift is as efficient, as it undoubtedly is, only when worked at high speed, a method of proceeding which is foreign to native ideas.

Lifts are now constructed for 5′, 10′, 15′, 20′, and 30′,

The sales of the lifts since May last up to date and for the same period in the previous year were as under :—

Height of lift.	Sold.		Given for trial.	
	1881-82.	1882-83.	1881-82.	1882-83.
5′ ...	4	4	...	1
10′ ...	...	2	...	1
15′ ...	6	2	...	2
20′ ...	20	21	2	1
30′ ...	...	3	...	...
Total ...	30	32	2	5

As encouraging facts, it may be stated that a zamindar from a distant village of Bundelkhand commissioned a bania of Cawnpore to purchase eight pumps, sending carts for them and clamouring because they were not ready immediately. It seems that he purchased one two years ago and acted on experience. In another case a talukdar of Oudh returned one for repairs which he had managed to break, and also said that it would not work. A mistri was sent back with the

lift to put it up and explain the working, and then came a letter asking for another lift to be sent as quickly as possible in addition to the first.

25. **Winnowers.**—For the driving band in the old machines a press-wheel has been substituted with advantage. Six were disposed of between June 1st and November 30th, 1882.

26. **Maize-shelling machine.**—A very simple and efficient machine was received from Messrs. Heebner and Sons, U.S., at a cost to Cawnpore of Rs. 78. It is worked by one coolie and requires two boys to feed it. As shown in the following table, it is far cheaper than hand labour, and would suit for Tarai cultivation, where maize is plentiful and labour scarce:—

Mode of hulling.	Number of labourers.	Total amount of wages per day.	Quantityof hulled grain per day.	Cost of hulling per maund of grain in annas.
		Rs. a. p.	lb.	
Corn-sheller	Two men and two boys.	0 7 6	789½	·77
By stick	Six boys ...	0 7 6	388	1·58
„ charpai	Six women ...	0 7 6	109	5·64
„ khurpi	Ditto ...	0 7 6	132	4·65
„ hand	Ditto ...	0 7 6	142	4·30

It was exhibited at Bijnor, Khairabad, and Saháranpur, and seemed to take the fancy of the people exceedingly.

27. **Emery saw-gin with Dr. Forbes Watson's Improvements.**—One was procured during the year in consequence of a recommendation in its favour received through the Government of India. For cleaning American cotton it is most efficient, giving cleaner cotton at 10 annas per maund than the native churka produces at Rs. 2-8-0 per maund. It is not however adapted for cleaning short-stapled native cotton, as was shown years ago by Sir Walter Cassel in his Cotton Handbook for Bombay.

In conclusion it may be noted that I have merely reported on the Farm operations, and that their initiation was due to Mr. Fuller, while the work of carrying out Mr. Fuller's plans was most efficiently conducted by the Superintendent, Lachman Parshad Barma.

D. G. PITCHER, MAJOR,
Asst. Director for Oudh.